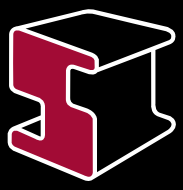


Structural Integrity
Associates, Inc.®
NUCLEAR PLANT SERVICES

Structural Integrity Associates, Inc. will be recognized as the most trusted independent provider of innovative, best in value, fully integrated engineered solutions to the Energy industry.

CORPORATE SNAPSHOT

- **Employee-owned company founded in 1983 in San Jose, CA**
- **Branch offices througout the United States and Canada, as well as overseas affiliates**
- **250+ employees providing consistent innovation and service**

ABOUT STRUCTURAL INTEGRITY

Structural Integrity Associates, Inc. (SI) is a leading engineering and consulting firm dedicated to the analysis, control, and prevention of structural and mechanical failures. The company was founded in 1983 in San Jose, CA, and has since opened branch offices throughout the United States and Canada, as well as established overseas affiliates.

We're able to integrate a full scope of services, from inspection and condition assessment, to monitoring and remaining life analysis, repair or remediation, and ultimately, total risk management of critical equipment and structures.

Our history is one of innovation marked by a creative multi-disciplined approach to component evaluation and repairs, as well as development of increasingly sophisticated tools reflecting a unique blend of technical expertise with the latest computer and expert system technologies.

Over the years, Structural Integrity has established itself as an innovative and responsive resource for answering virtually any challenge in the analysis, control, and prevention of failures in critical equipment. Our experience ranges from R&D to engineering, metallurgy, and fabrication; from petrochemical to nuclear and fossil-fueled power plant support.

NUCLEAR PLANT SERVICES

Operating and maintaining a nuclear power plant, renewing the license of an older nuclear plant, or licensing, designing, and constructing a new nuclear plant – all are monumental efforts that few utilities care to tackle entirely on their own. Most utilities need the support and engineering services, monitoring systems, analytical software, and industry-specific training that can come only from an engineering consulting firm that has grown with the nuclear industry.

Structural Integrity Associates, Inc. has provided support and engineering services to both domestic and international nuclear utilities for more than 25 years. In fact, engineering assessments, repairs, and consulting services for nuclear plants were Structural Integrity's first business offering in 1983. Since then, nearly every nuclear utility in the United States – and many internationally – have relied on our support. In addition to resolving plant issues, our professional staff is active in the leadership and support of ASME, NACE, ASNT and other standards organizations, and we develop technology and software that have become nuclear industry mainstays.

SI PRODUCTS & SERVICES INCLUDE:

CORPORATE MILESTONES

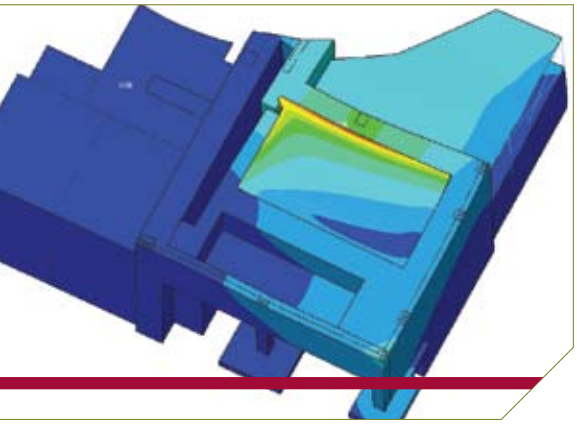
- **1983 – Company Founded in San Jose, CA**
- **1985 – Established Infometrics; NDE Products Business in Washington, DC Area**
- **1989 – Established Fossil Plant Services in Uniontown, OH**
- **1991 – Acquired IST, Inc. and Focused Array UT Inspection Technology in Ft. Lauderdale, FL**
- **1995 – Opened Charlotte, NC Office**
- **2000 – Opened Denver, CO Office**
- **2002 – Established Materials Science Center in Austin, TX Office**
- **2002 – Opened Stonington, CT Office**
- **2004 – Acquired GWUT Technology; Established Pipeline Services Group**
- **2005 – Established Structural Integrity Canada in Toronto, Ontario**
- **2007 – Established Structural Integrity Expert Solutions in Salt Lake City, UT**

BWR REACTOR INTERNALS MANAGEMENT

BWR reactor pressure vessel internals cracking occurred at many units early in plant life. The industry responded with an industry-wide BWR Vessel and Internals Project (BWRVIP) in 1994, which addressed all BWR internals and helped avoid mandated NRC shutdowns by instituting and executing plans to resolve issues. Structural Integrity has specialized expertise in managing BWR vessel internals, and can support utilities in implementing various aspects of the BWRVIP's Inspection and Evaluation Guidelines, including proactive analysis, outage preparation, and repair/replacement reviews. As structural margins decrease with aging, more sophisticated analysis methods may become necessary to reduce conservatism and to gain margins, and we utilize advanced linear-elastic and elastic-plastic fracture mechanics methods to evaluate internals degradation.

CANDU REACTOR SUPPORT

Especially since the advent of SI Canada (located in Toronto), SI has been involved in a number of projects with the CANDU fleet (Pressurized Heavy Water Reactors). Most notable is our experience in assisting with the analysis, testing, process development, licensing, and conceptual tooling to support weld overlay repairs of FAC-thinned feeder pipes. Other CANDU projects completed to date address topics including fatigue management, dynamic pressure monitoring, risk-informed ISI and advanced fracture mechanics training. Our core capabilities, combined with our knowledge of CANDU plant design and operation gained through recent projects, make us a substantial engineering services resource to CANDU operators around the world.

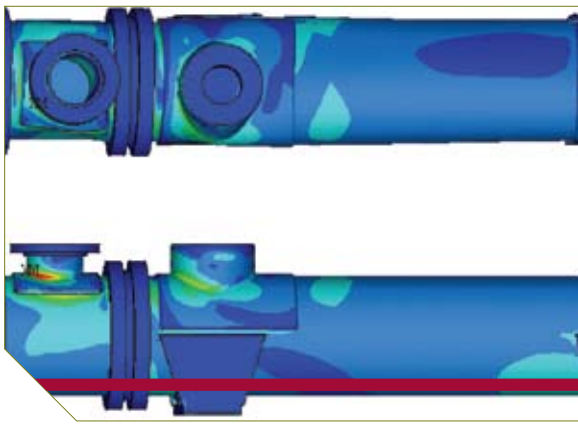


CONCRETE STRUCTURE ANALYSIS

Concrete structures perform important functions at nuclear power plants, providing shielding, support and containment for safe operation. About 80% of the primary or secondary containment structures in nuclear power plants are constructed of pre-stressed or reinforced concrete, and a host of concrete structures and components exist at the sites. These structures are generally durable and trouble-free, but certain environmental conditions or changes in loading can necessitate re-evaluation. Structural Integrity has specialized expertise in finite element analysis of concrete structures using ANSYS and LS-DYNA (ANSYS, Inc.). We're also involved in research relating to aging of concrete for long term operation of nuclear power plants.

FABRICATION ENGINEERING SUPPORT

With market demand for replacement components (and soon a growing demand for new plant components), Structural Integrity has been active in providing design engineering services to fabricators. The design/analysis requirements to qualify a component to ASME Code criteria can vary from the relatively straightforward to the more sophisticated. We have extensive experience in qualifying all classes of components, from the most safety-significant (e.g., Section III Class 1 reactor vessels) to non-safety related components evaluated to Section VIII requirements. Appropriate primary and secondary stress criteria, as well as peak stress and fatigue evaluations, are considered. Analyses vary from closed-form solutions for primary stresses to detailed finite element analyses for more complex configurations. Support can be provided that ranges from engineering support for ASME certification to developing complete design/analysis packages. All work is performed under our quality assurance program.

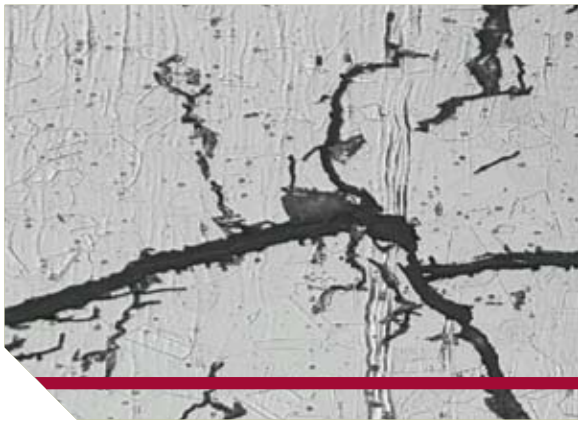


FABRICATION OVERSIGHT

Design, fabrication, and construction have begun on new nuclear power plants and will continue over the coming decades. In addition, operating plants' need for large replacement components continue. Ideally, lessons from past component fabrication, plant construction and operation will be factored into the design, fabrication, and installation of these new units. The present generation of design and construction personnel may lack the necessary industry experience to include solutions to known degradation issues associated with former design, fabrication, and construction practices. Structural Integrity, with years of nuclear industry experience, and staff who have personally developed solutions to past degradation issues, stands ready to help avoid known problems by performing detailed reviews of new plant designs, fabrication plans, and installation methods. Areas where third-party review by Structural Integrity can prove especially valuable to new plants and components on the drawing board or under construction include stress analysis, materials selection/specification, fatigue evaluation, corrosion, and welding/inspection.

FRACTURE MECHANICS ANALYSIS AND RISK ASSESSMENT

When a flaw is found in a reactor pressure vessel, piping, or other nuclear plant component, fracture mechanics calculations are used to analyze and predict flaw behavior, including crack growth rates and critical crack sizes. Structural Integrity uses deterministic and probabilistic fracture mechanics techniques, including finite element analysis, to disposition flaws in a variety of materials, geometries, and applied stress fields. Specialized fracture mechanics software developed and used by Structural Integrity includes pc-CRACK, often employed for ASME Code Section XI flaw evaluations and weld overlay design; ANSC, used for net section collapse analysis for arbitrarily flawed sections in ductile materials; and EPRI's Viper/Viper-Noz, which was also developed by Structural Integrity and is used to determine probability of failure for reactor pressure vessel welds and nozzles.



HEAT EXCHANGERS AND CONDENSERS

Nuclear plants contain lots of heat exchangers, ranging from the large (condenser) to the small (miscellaneous coolers); high energy (steam generators) to low energy (service water system HXs); safety related (essential service water) to non-safety related (miscellaneous coolers); and regenerative (MSRs) to once-through (condenser). Heat exchangers are degraded by fouling (loss of heat transfer), cracking (loss of structural integrity), localized thinning and pinhole leaks (plugging), and wear. SI's expertise in disposition, mitigation, and control of all known degradation mechanisms, as well as in NDE, provides the high level assistance that the heat exchanger owner needs to maintain system and plant reliability and safety.

HIGH-DENSITY POLYETHYLENE (HDPE) PIPING

Today, a growing number of nuclear power plants are installing High-Density Polyethylene (HDPE) piping in non-safety related and safety related systems. The reason for growing interest in HDPE is its extended service life, ease of installation, and cost savings. Compared to its carbon steel and cast iron counterparts, HDPE does not rust, rot, or support biological growth. This assures maximum water flow throughout the system with increased reliability. In support of the power industry's growing HDPE needs, Structural Integrity is at the forefront by offering integrated, comprehensive engineering solutions including Non-Destructive Examination (NDE), fracture mechanics, materials analysis, piping design, fabrication and installation oversight, and licensing support for replacement of existing piping systems or new plant installations.

LEAK-BEFORE-BREAK EVALUATIONS

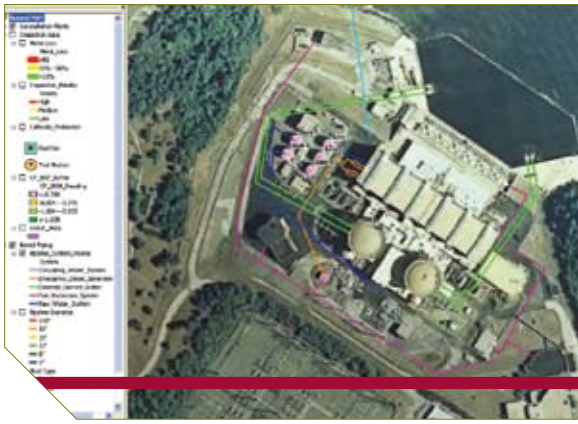
Leak-before-break (LBB) evaluations may be used to eliminate consideration of the dynamic effects of pipe rupture in nuclear reactor coolant systems, justifying no requirements for pipe-whip restraints and jet impingement barriers. The NRC's LBB evaluation criteria include demonstrating a low probability of pipe degradation; determining maximum critical flaw size via fracture mechanics analysis; performing thermal-hydraulic analysis to determine leakage for one half the critical size for normal plant operation; and finally demonstrating that there is adequate margin between predicted leakage and plant leakage detection capability. Structural Integrity has performed NRC-accepted LBB evaluations at numerous nuclear plants, including evaluations of piping as small as 6" diameter. We have has also evaluated the effects of weld overlays on LBB performance.

LICENSE RENEWAL

In the United States, after a nuclear reactor has been in operation for 40 years, operating licenses may be renewed for another 20 years, provided it can be demonstrated that the unit will maintain adequate safety levels over the extended period of operation. Similar requirements exist for plants outside the United States. Most U.S. plant owners have sought or will seek extended operating licenses, and most find the need for technical support to see them through the NRC license renewal process. Structural Integrity provides comprehensive license renewal support, and has provided consultation and support to the majority of the utilities that have sought license extensions to date. Support services include preparation and review of License Renewal Applications (LRAs), fatigue evaluations, analyses/evaluations initiated by Aging Management Reviews (AMRs), responses to NRC questions on LRA submittals, and support for implementation of LRA commitments. We also prepare and review management programs to address age-related degradation, including Fatigue and Neutron Embrittlement Aging Management Programs.

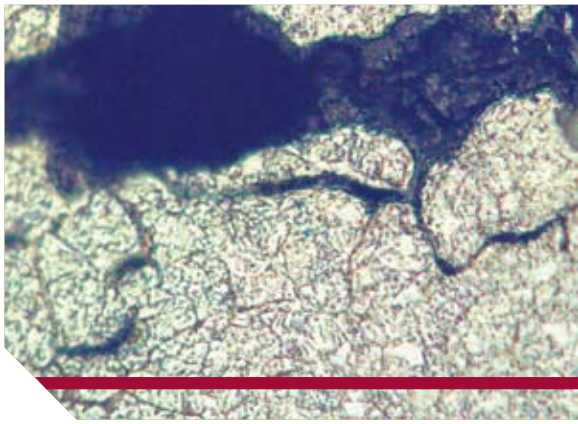
MANAGEMENT OF AGING BURIED PIPING

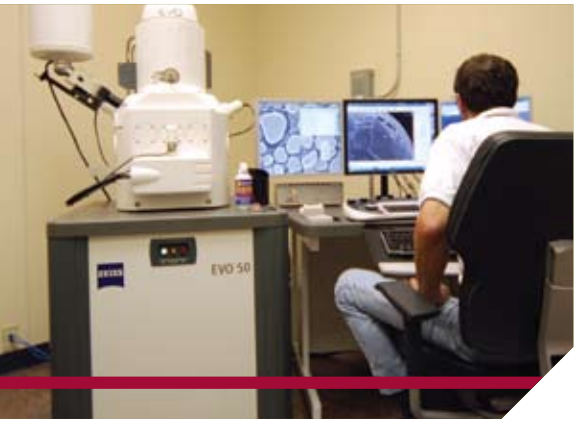
Many nuclear units have operated for more than 30 years, with buried piping systems that may be experiencing degradation. Using guidance from the Nuclear Energy Institute (NEI) and the Electric Power Research Institute (EPRI) for buried piping programs, Structural Integrity has developed a systematic buried piping management program that includes data collection; risk assessment; a baseline assessment plan; indirect and direct inspections, including inspection with Structural Integrity's long-range, guided-wave ultrasonic G-Scan technology; remediation or mitigation as needed, including improved cathodic-protection anode beds and rectifiers; monitoring; and prioritized maintenance.



MATERIALS/METALLURGICAL/CORROSION EVALUATIONS

Accurate materials, metallurgical, and corrosion evaluations are essential to the appropriate disposition of degraded plant components. Such evaluations also help identify improved materials and fabrication processes to prevent future degradation. Structural Integrity offers a complete range of materials engineering services, supported by our full-service metallurgical laboratory in Austin, TX. Our materials engineering specialties include welding engineering; corrosion and stress corrosion cracking evaluations; materials selection; and corrosion-fatigue and creep assessments. Low-temperature and high-temperature corrosion phenomena, including microbiologically influenced corrosion, are a particular area of Structural Integrity expertise.



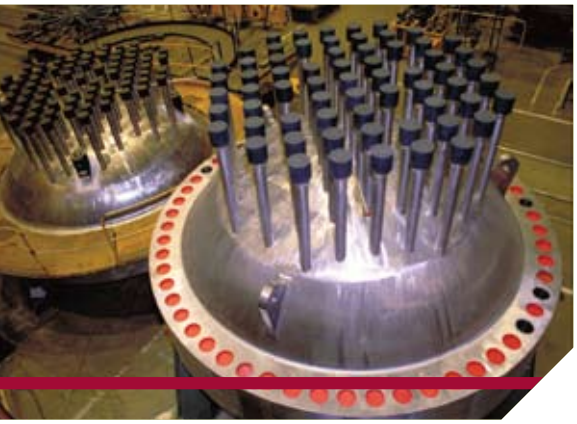


METAL FATIGUE EVALUATIONS

Metal fatigue from nuclear plant cyclic stresses and strains is a major contributor to degradation of aging components – and a specialty at Structural Integrity. In fact, EPRI relied on Structural Integrity's metal fatigue expertise to develop the EPRI Fatigue Management Handbook as well as FatiguePro, a widely used, real-time thermal fatigue monitoring system that automatically tracks fatigue usage and transients for critical nuclear components. Our metal fatigue services and products include FatiguePro evaluations; fatigue management handbooks that help identify potential damage locations; fatigue repair support; design of modifications to extend component fatigue life; analysis of reactor vessels and piping to determine effects of reactor water environment on fatigue life; determination of fatigue impact of cyclic thermal stratification in reactor piping; and vibration fatigue management.

NEI 03-08 AND MATERIALS DEGRADATION MANAGEMENT PROGRAMS

The nuclear industry's Materials Initiative NEI 03-08, developed in response to events involving materials degradation in nuclear plants, requires a Materials Degradation Management Program at all PWR and BWR units, in addition to audit of these programs by INPO. At a minimum, the programs must address BWR vessels/internals, Alloy 600 issues, reactor vessel integrity, PWR vessels/internals, boric acid corrosion control, steam generator management, primary and secondary system water chemistry, and fuel reliability. Any deviations from mandatory/needed program requirements require supporting documentation. Structural Integrity can support nuclear plants in Materials Degradation Management Program development, implementation, deviation requests, third-party reviews, utility training, preparation for INPO audits, and all related services.



NEW PLANT CONSULTING

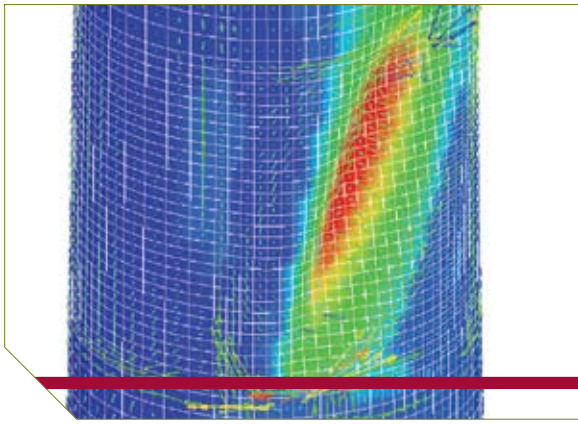
Electricity demand in the United States is projected to climb 25% by 2030, and the NRC is already reviewing a wave of applications for new nuclear plants (17 applications for 26 units) to meet this future demand. Engineering and licensing a new nuclear unit can be daunting, but Structural Integrity's extensive experience with the previous generation of nuclear units places us in a unique position to provide new plant support. Available services for new plants include design analysis/third-party design review, design specification preparation and review, stress and fatigue analyses, welding/material engineering, fabrication review, fracture toughness/pressure-temperature curves, probabilistic risk assessment reviews, and licensing support. We can also provide ASME Code consultation, startup vibration testing, buried piping support, fatigue and condition monitoring programs, inspection programs, and training programs.

NONDESTRUCTIVE EXAMINATION

Nondestructive examination (NDE) is one of Structural Integrity's most well-known specialties. New inspection technologies are continually developed by our NDE applications group, and its top-notch technical staff is dispatched to conduct inspections with these and other state-of-the-art NDE technologies worldwide. NDE services available specifically for nuclear plants include austenitic/ferritic piping inspections (Appendix VIII, Supplements 2, 3), vessel shell inspections (Supplements 4, 6), dissimilar metal weld inspections (Supplement 10), weld overlay repair inspections (Supplement 11), and ultrasound inspections in lieu of radiography (ASME Section XI Code Case N-659-1). Structural Integrity also offers comprehensive turbine-generator inspections, including examinations of turbine rotor bores, blade attachments, disc rims, blade tenons, casings, peripherals, generator retaining rings, rotor dovetails, and coupling keyways. Structural Integrity offers guided wave ultrasonic G-Scan inspections for screening evaluations of plant piping (including buried piping). We're also available for third-party inspection oversight.

NONLINEAR TRANSIENT DYNAMIC ANALYSIS

In cases of drop, impact, shock, and events requiring highly nonlinear analysis, explicit finite element analyses are indicated. Structural Integrity can provide solutions to such problems using LS-DYNA, a 3-D nonlinear dynamic analysis code. Nuclear applications of explicit finite element analysis include airplane impact in design of reactor buildings, drop evaluations of spent fuel storage casks and other heavy lifts, as well as internal projectiles. Structural Integrity offers drop and impact evaluations as well as dynamic and psuedo-static analyses of eroding materials, rate-sensitive response, seismic loading, and post-peak behavior.

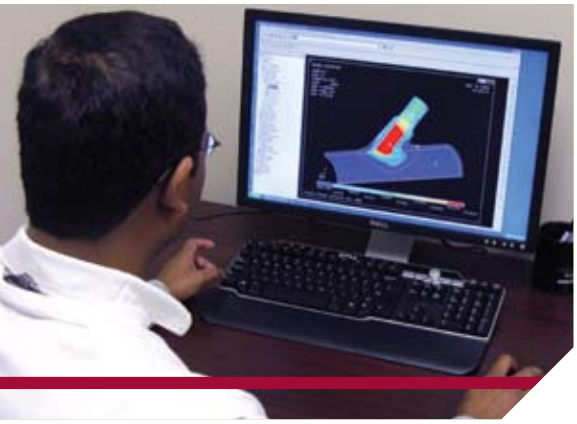


OPERABILITY EVALUATIONS

As the nuclear fleet continues to age, the likelihood of identifying non-conforming conditions during plant operation increases. Once a non-conforming condition is discovered, crucial plant operability decisions must be made, usually on a rapid turn-around basis. These decisions are not always easy. Plant operators often require in-depth engineering support to help establish a technical basis for such important decisions. Structural Integrity stands ready to provide rapid response for a wide range of nuclear plant operability evaluations, including piping and component wall-thinning analyses; root-cause failure investigations; evaluations of leaking piping or other components; vibration analysis and monitoring; structural and stress analyses; fracture mechanics analyses; thermal-hydraulic analyses; and ASME Code evaluations, including technical defense with the regulator.

OUTAGE PLANNING AND SUPPORT

The planning and execution of nuclear plant outages stretches plant staff to the utmost. When outage season looms, it may be reassuring to know that Structural Integrity's engineering and technical staff are on standby to help industry clients with every outage assignment: planning, condition assessment, repairs, nondestructive examination, stress and fracture analyses, materials and process selection, financial-based optimization, and more. Our vast range of expertise encompasses plant components including reactor vessels, vessel internals, turbine-generators, piping, and balance of plant.



PIPING ANALYSIS

Sophisticated piping analysis – and the customized software for conducting it – are Structural Integrity specialties. Examples of our complex piping analyses used to resolve nuclear plant design and operational issues include ASME Class 1 design transient evaluations for extended license operation; thermal stratification analyses in pressurizer surge, feedwater, and spray piping; piping vibration evaluations involving socket weld cracking; analyses of flow-induced vibration in piping systems; evaluations of flow-accelerated corrosion-induced wall thinning; analyses of power uprate changes; and seismic analyses. Our proprietary software is used for analyzing thermal stratification, vessel fatigue, wall thinning, thermal shock at transitions, vibration loading, and other specific conditions. Structural Integrity also uses PIPESTRESS (DST Computer Services, SA) for ASME Class 1, 2, 3, B31.1, and B31.3 piping analyses, and ANSYS, Inc.'s ANSYS for ASME Code, Section III, NB-3200 finite element analyses.

PRESSURE-TEMPERATURE CURVES AND RPV MATERIAL SURVEILLANCE

Reactor pressure vessel (RPV) material surveillance programs are required for all U.S. PWRs and BWRs. The results of these surveillance programs are used to develop pressure-temperature (P-T) limit curves that incorporate appropriate safety margins to protect against brittle fracture of RPVs, particularly in the irradiated beltline region. These P-T limit curves must be re-evaluated using new surveillance data in situations such as license renewal, power uprates, or when revised fluence calculations affect adjusted reference temperature values. Structural Integrity, well-experienced in P-T curves and vessel integrity for both PWRs and BWRs, can provide utilities with technical support including materials reviews, P-T curve development, P-T limits reports (PTLRs), reactor vessel integrity/ P-T limit curve training, vessel fluence evaluations via TransWare Enterprises, Inc., and many other areas.

PRIMARY WATER STRESS CORROSION CRACKING

Primary water stress corrosion cracking (PWSCC) can occur in PWR primary systems where Alloy 600 components and associated Alloy 82 (GTAW) and Alloy 182 (SMAW) welds were used. Such components and welds were widely applied in PWRs. Prompted by recent experience with PWSCC in PWR Alloy 82/182 butt welds and small-bore penetrations, as well as by new examination and mitigation requirements in the Materials Reliability Program (MRP) Primary System Piping Butt Weld Inspection and Evaluation Guideline (MRP-139), many PWRs are now undergoing PWSCC examinations and repairs. New concerns have been raised for SCC of stainless steels in PWRs. Structural Integrity and its field repair partner, Welding Services Inc., are leaders in these weld overlay butt weld repairs, as well as in nozzle repairs for small-bore primary system penetrations. Our team, WSI^2, has completed over 20 large-scale weld overlay projects encompassing more than 150 weld overlays in just two years in response to MRP-139 – and not a single welded repair was required for any of these overlays.

PROBABILISTIC FRACTURE MECHANICS ANALYSIS AND RISK ASSESSMENT

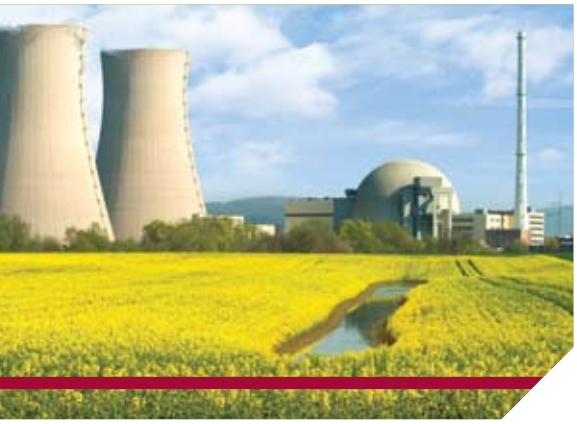
Probabilistic fracture mechanics (PFM) analysis takes conventional deterministic fracture mechanics analysis a step further, using selected random variable inputs for situations that involve a significant degree of uncertainty – such as in crack size, or scatter in test results – and PFM analyses usually yield a failure probability, rather than a specific calculation of crack size or lifetime. Structural Integrity has applied PFM analysis to piping, reactor-head penetration nozzles, and other nuclear plant components. Many of our PFM analyses employ WinPRAISE, originally developed by SI employees under NRC sponsorship. Our latest version of the software, WinPRAISE 07, can analyze crack initiation and growth due to fatigue, IGSCC, PWSCC, and flow-accelerated corrosion. WinPRAISE is available for purchase from Structural Integrity in easy-to-use Windows format.

PWR REACTOR INTERNALS MANAGEMENT

Concerns about aging degradation of PWR reactor pressure vessel internals have become a high priority as nuclear units approach license renewal. Renewal applications must consider the effects of aging in order to meet conditions defined in the NRC's Generic Aging Lessons Learned Report. In response, the MRP's Reactor Internals Focus Group (RI-FG) has prepared inspection and evaluation guidelines for managing the effects of aging degradation in PWR internals. The guidelines, issued under the NEI 03-08 Materials Initiative, include developing an Aging Management Program (AMP) and inspection plan for PWR internals. Structural Integrity, working closely with the MRP RI-FG, has beta-tested the draft guidelines for several PWRs. We provide technical support for plants considering aging management reviews for license renewal, or for plants developing AMPs to manage the effects of aging in PWR internals.

REACTOR PRESSURE VESSEL INTEGRITY

Radiation embrittlement is a known degradation mechanism in ferritic steels, and the beltline of reactor pressure vessels is particularly susceptible to radiation damage. The effects of radiation on vessel materials have impacted heatup/cooldown limits for PWRs, and increased hydrostatic test temperatures for BWRs, thereby significantly limiting plant operation. Structural Integrity, with strong expertise in managing reactor vessel embrittlement and vessel integrity, can provide nuclear plants with technical support in a number of areas, including pressure-temperature curve development; materials evaluations; third-party reviews of RPV materials surveillance program results and implementation; setpoint evaluations; pressurized thermal shock evaluations; vessel fluence evaluations; and evaluations of projected vessel properties and pressure-temperature limits for license renewal applications. We've also worked with ASME for the past 15 years to improve PWR and BWR heatup and cooldown limits.



RISK-BASED PROGRAMS

Risk-Informed In-service Inspection (RI-ISI) is a cost-effective alternative to current ASME Code, Section XI inspection requirements that uses risk assessment in addition to information on component-specific degradation mechanisms as the basis for a nuclear plant piping inspection program. Structural Integrity played a key role in the development of EPRI's NRC-approved RI-ISI and RIS_B (Risk-Informed Safety-Based) methodologies, the latter a streamlined RI-ISI methodology that takes advantage of the lessons learned through over 10 years of industry RI-ISI experience. To date, we have supported ASME Code Case N-560, N-578 and N-716 evaluations using the EPRI RI-ISI methodology at 49 nuclear units (36 PWRs and 13 BWRs). In all cases, the methodology has proven to significantly reduce the number of piping inspections compared to Section XI, with negligible impact on plant risk. Additionally, Structural Integrity has experience in application of risk-informed technologies to Break Exclusion Region program piping, as well as in performing RI-ISI Living Program Updates, either as part of Interval ISI Program Updates or as stand-alone evaluations.

ROOT-CAUSE FAILURE ANALYSIS

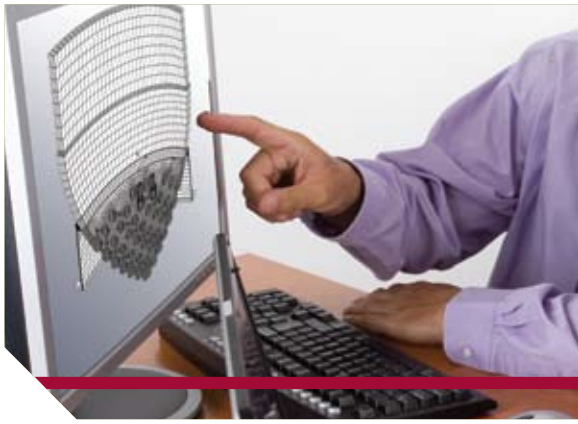
At the bottom of every plant component failure is a root cause, and root-cause failure analyses are a proven way to avoid repeat or related failures. Structural Integrity offers a complete range of root-cause failure analyses, varying in complexity from one or two specialists focused on material fractography to a multi-discipline team performing a full-scope investigation. To support its investigations, we maintain both a metallurgical laboratory and an advanced nondestructive testing capability. Additionally, we perform human-error analyses and organizational/programmatic evaluations to uncover possible contributing factors. Structural Integrity is also available to perform third-party reviews of root-cause failure analyses, and evaluations of corrective-action programs.

SERVICE WATER

Nuclear plant service water systems are affected by a multitude of situations and operate under a wide variety of operating conditions. The differences in design, materials, water chemistry, and operation necessitate plant-specific approaches for inspection, management of degradation, corrosion mitigation, repairs and replacements. Management approaches may be reactive (e.g., leaks present themselves, thinning is detected by inspections, run vs. repair decisions made on critical path) or preventive (proactive inspections on selected locations, heat transfer testing, water treatment, cleaning, monitoring, planned/staged repairs and replacements). Structural Integrity's expertise in corrosion and corrosion control, materials engineering, vibration, fracture mechanics, stress analysis, statistical methods, root-cause failure analysis, and NDE provide the multidisciplinary approach required for proactive, cost-beneficial management of service water system degradation.

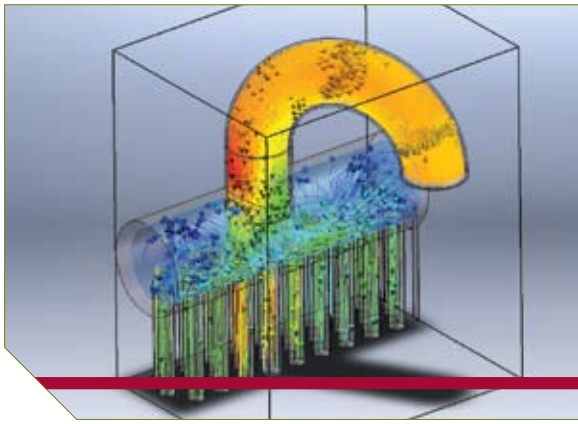
STRUCTURAL AND STRESS ANALYSIS

The performance of complex structures under thermal, static, and dynamic loadings is a crucial question at nuclear plants. Armed with an array of state-of-the-art computer codes and analytical techniques, Structural Integrity can provide linear-elastic and non-linear structural and stress analyses for nuclear plant components and systems, including pressure vessels, tanks, piping systems, pumps, tubing, headers, heat exchangers, valves, reactor internals, and turbines. Examples of stress analysis codes employed by Structural Integrity range from ANSYS finite element software (ANSYS, Inc.), to PIPESTRESS (DST Computer Services, SA) for piping system analysis, to Structural Integrity's own specialized programs, including TOPBOT, used to determine stress distributions in stratified piping systems, and PIPE-TS2, used to calculate through-wall thermal gradient stresses for piping thermal transients.



THERMAL-HYDRAULIC ANALYSIS

Thermal-hydraulic analyses of nuclear plant components and structures are used to determine loadings on related components. Structural Integrity conducts a full array of steady-state and transient thermal-hydraulic analyses, using either standard textbook methods, Computational Fluid Dynamics (CFD) or specialized software, including SI-proprietary software. Examples of complex problems that we have solved via thermal-hydraulic analyses: evaluation of severe wall thinning in piping beyond a feedwater heater drain tank found that insufficient back-pressure and two-phase flow conditions were the culprits; analysis of reactor containment pressure-temperature response justified conducting BWR reactor pressure tests at elevated temperatures with open containment; PWR thermocouple test data were evaluated to determine the internal piping flow and stratification conditions that exist during various operational modes; and analyses have determined stratified flow levels and heat transfer coefficients in piping systems subject to such stratified flow.



TURBINE-GENERATOR ASSESSMENTS

Turbine-generators – the business end of every nuclear plant – have to be in top operating condition. Reliable turbine-generator inspections and assessments are critical to avoiding unanticipated repairs and untimely failures, while at the same time steering clear of unnecessary repairs and replacements. Structural Integrity provides complete turbine-generator inspection and life-assessment services, including boresonic rotor inspections and linear phased-array ultrasonic inspections of rotor shafts, as well as EPRI-licensed SAFER rotor integrity and life analysis, EPRI RimLife rotor assessments, EPRI RRingLife evaluations of retaining rings, and other evaluations. Structural Integrity also offers bore honing and machining in addition to its other turbine-generator services.

VIBRATION ANALYSIS AND MONITORING

Vibration-related nuclear plant piping problems – whether in small-bore piping, socket welds, large bore piping, or anywhere in between – can be difficult to resolve. Structural Integrity, with years of experience in structural dynamics, stress analysis, vibration testing and analysis, and applied mechanics and materials, can step in to solve nuclear plant vibration issues. Examples of recent vibration-related projects include evaluation of the effects of power uprate on small-bore piping, and design and implementation of a vibration monitoring system for main steam piping. Using our vibration expertise, we developed customized data acquisition systems that collect and analyze vibration monitoring data, including the portable SI-MiniDAS and the high-speed, automated SI-VersaDAS. These systems are used for Structural Integrity projects and are available for purchase or lease by utilities.

WALL THINNING EVALUATIONS

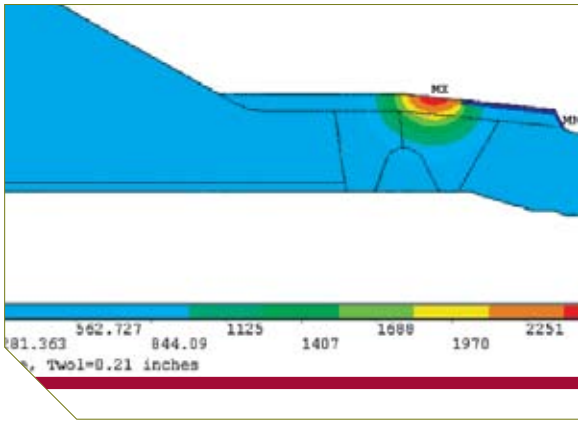
Even when local wall thinning in nuclear pressure vessels, piping, valves, or other components is well below the general minimum wall thickness required by ASME Code, continued operation may be justified by ASME-approved evaluations. Structural Integrity is a leader in wall-thinning evaluations for nuclear plants, including evaluation of mechanisms and rate of thinning, as well as familiarity with applicable ASME Code criteria. In fact, the evaluation methods in ASME Section XI Code Cases N-480, N-513, and N-597 were based on a Structural Integrity report generated for EPRI (N-480) or developed by the Code committees with significant SI contributions. We use either the simplified analytical methods found in those three ASME Code Cases, or more-complex finite element models that determine local stress distributions in thinned components. In situations where there is local through-wall leakage, we conduct fracture mechanics analyses to demonstrate sufficient margin against fracture. With our unique industry expertise, we can complete wall thinning evaluations quickly, enabling rapid run/repair/replace decisions.

WATER CHEMISTRY AND CORROSION MITIGATION

Intergranular stress corrosion cracking (IGSCC) in BWRs and primary water stress corrosion cracking (PWSCC) in PWRs, as well as microbiologically influenced corrosion (MIC), are perennial industry concerns. These corrosion mechanisms, as well as many others, are influenced by water chemistry and especially water chemistry transients, and Structural Integrity's longtime water chemistry experience can help utilities mitigate these problems in vessels and piping. We provide corrosion mitigation and remediation consulting, addressing techniques including hydrogen water chemistry (HWC) and zinc injection plus noble metal technologies for BWRs, and elevated hydrogen and zinc injection for PWRs. Structural Integrity also offers corrosion-related weld overlays and repairs, crack growth rate modeling, alloy selection, failure analysis, MIC mitigation, and support for license renewal and NRC inspection issues involving corrosion.

WELD RESIDUAL STRESS ANALYSIS

Certain welding processes – pipe-to-pipe butt welds, small-bore penetration J-groove welds, and weld overlay repairs, for example – leave residual stresses that can affect the stresses within welded nuclear plant components. Structural Integrity offers a full range of temperature-controlled, non-linear, path-dependent weld residual stress analyses, using ANSYS finite element analysis software (ANSYS, Inc.) to simulate various welding processes. These analyses simulate a thermal pass, complete with appropriate weld heat input, heat efficiency, and appropriate cooling time, to determine temperature distributions due to the welding process. A simulated stress pass in turn calculates residual stresses due to non-linear, elastic-plastic load/unload stress-reversal cycles from the heating and cooling of the weld elements throughout the thermal transients. For especially complicated weld geometries, we can perform three-dimensional moving heat source residual stress analyses.



WELDING ENGINEERING

Appropriate weld design, procedures, and qualification are vitally important at nuclear plants. Structural Integrity offers comprehensive welding engineering services, including development and review of welding programs; selection and development of welding processes for critical applications; review and evaluation of procedure qualification records and weld procedure specifications; review of welder qualification; review and evaluation of weld failures; development of corrective actions; and welding code review and reconciliation. We're also available to develop innovative weld and repair techniques for specific situations. In fact, we pioneered development and application of weld overlay and temperbead welding for nuclear plant repairs.

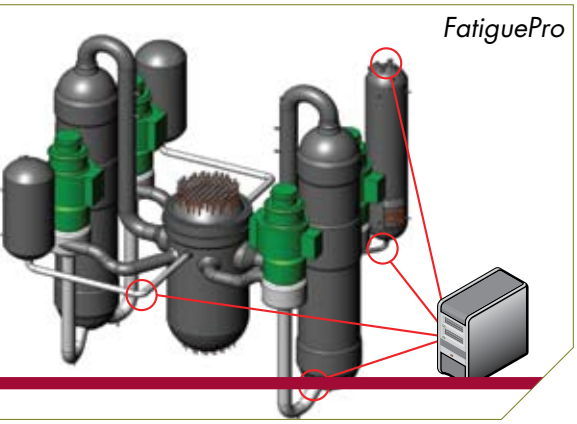
The prior Support Services and Engineering Disciplines listing is not intended to be comprehensive. Other information on the following topics and more can be found on Structural Integrity's Web site.

- *ASME Code Evaluations*
- *Heat Transfer*
- *Licensing Support*
- *Waste Storage and Design*
- *Weld Overlay Repairs*
- *BWR Feedwater Nozzles*
- *Canopy Seals Weld Overlay*
- *Steam Generators*

Structural Integrity also offers the following products and software:

BIoGEORGE™

Microbiologically influenced corrosion is an ever-present threat to nuclear plant service water systems, particularly standby and redundant systems – some safety-related – in wet layup for extended periods of time. Fortunately, the on-line, real-time BIoGEORGE monitoring system can provide early warning of biofilms before these rapidly forming films can get a toe-hold. BIoGEORGE also provides a reliable indication of the effectiveness of biocide treatments, plus feedback on biocide treatment selection, timing, and concentrations. BIoGEORGE is available only from Structural Integrity under EPRI license.

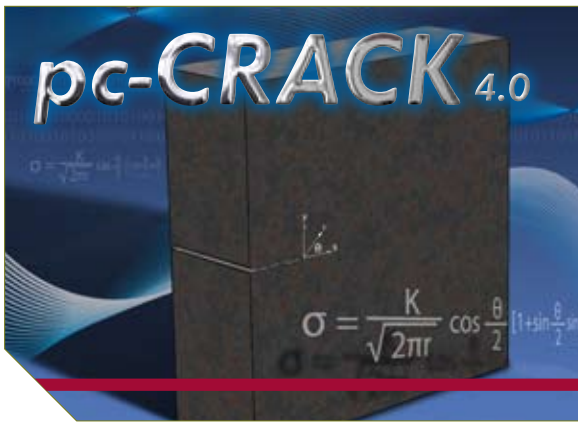


FATIGUEPRO™

Metal fatigue from cyclic stresses can shorten the life of critical nuclear plant components. But FatiguePro, a real-time fatigue monitoring software system developed by Structural Integrity under contract to EPRI, and licensed by EPRI, automatically tracks fatigue usage and transients in these key components using existing plant instrumentation. FatiguePro facilitates plant life extension/ licensing activities by providing an immediate, up-to-date and continual assessment of fatigue usage in all critical vessels and piping. As a result, this Windows-based software is used in more nuclear plants worldwide than any comparable system.

PC-CRACK™

Sophisticated fracture mechanics analyses are performed quickly and easily with Structural Integrity-developed pc-CRACK. The Windows-based software analyzes and predicts flaw behavior, including calculation of crack growth rates and critical crack sizes for pressure vessels, piping, steam turbines, and structures, with immediate display of analysis results. pc-CRACK applications include ASME Code Section XI flaw evaluations as well as weld overlay design.

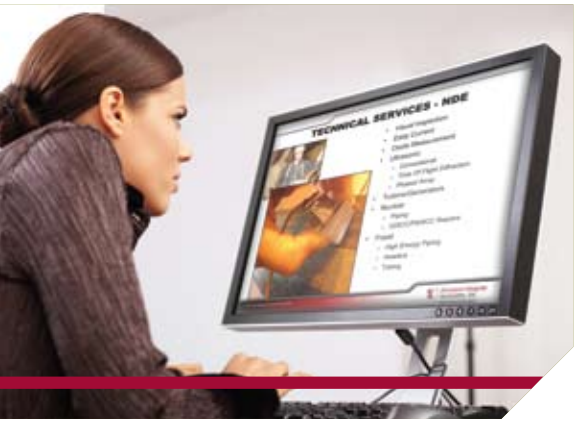


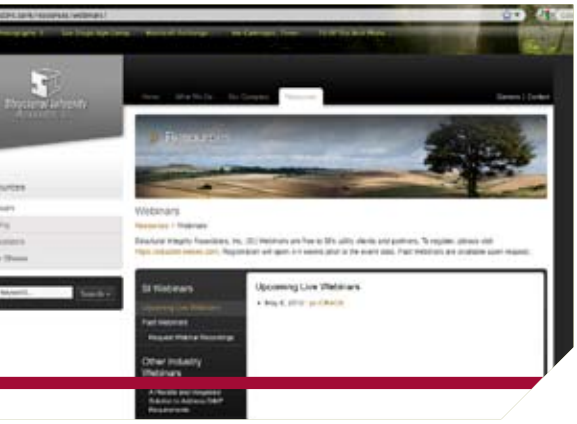
SI-VERSADAS™, SI-MINIDAS™, AND TTVMS™

Reliable vibration data is needed before any vibration issue can be resolved. Structural Integrity offers a line of data acquisition systems that collect and analyze vibration data, including portable SI-MiniDAS; high-speed, automated SI-VersaDAS; and real-time TTVMS (Transient Torsional Vibration Monitoring System), with both automated and manual acquisition capabilities. Structural Integrity's proprietary customized systems, either desktop or laptop-based, are suitable for problems involving small-bore piping, socket welds, large bore piping, turbine-generator rotors, and other vibration-prone components.

WINPRAISE™

Probabilistic fracture mechanics analyses of nuclear reactor vessels and piping can be expedited with WinPRAISE, originally developed for the U.S. NRC. The latest version of the software can analyze crack initiation and growth caused by fatigue, primary water stress corrosion, intergranular stress corrosion, and flow-accelerated corrosion. Windows-based WinPRAISE can analyze multiple failure modes, including leaks, large leaks, and LOCAs, in a single computer run.





WEBINARS

Structural Integrity provides webinars on numerous industry topics to our clients. A list of past nuclear plant services webinars follows. Visit our Web site at www.structint.com for a current schedule of upcoming webinars, related registration information, and archived versions of previously conducted Webinars that are available for viewing.

- Advancements in Finite Element Analyses for the Nuclear Industry
- ASME Section XI Flaw Evaluation for Nuclear Components
- Buried Piping Integrity Initiative
- BWR Reactor Pressure Vessel Internals
- Cathodic Protection: Application & Testing in Plants
- Code Case Evaluation of Piping Flaws and Weld Thinning
- Failure and Root-Cause Analysis
- Financial Risk Optimization for Run/Repair/Replace Timing
- Finite Element Concrete Analysis Fundamentals and Applications
- Fundamentals of Welding, Part 1, Overview
- Fundamentals of Welding, Part 2, Nuclear Applications
- Generator Rotor Inspection and Life Assessment
- G-Scan for Safety-Related Piping at Nuclear Plants
- High-Density Polyethylene Pipe Nondestructive Examination
- Introduction to Flow Induced Vibration
- Introduction to Nuclear Plant Services
- Introduction to Phased-Array Ultrasonic Technology
- Introduction to Stress Corrosion Cracking
- Leak-Before-Break Methodologies for Reactor Coolant Systems
- License Renewal Part 1, Fatigue Management
- License Renewal Part 2, Environmental Fatigue
- Managing Aging PWR Internals
- Management of Aging Buried Nuclear Piping & Tanks
- NEI 03-08 and Materials Degradation Management Programs
- Nuclear Plant Heat Exchanger/Condenser Asset Management
- pc-CRACK
- Pipe Thermal Stratification
- Pressure-Temperature Limits
- Recent and Pending Changes to ASME Section III Piping Codes
- Risk-Informed In-Service Inspections for Nuclear Plants
- Service Water System Issues
- Turbine and Generator Rotor Bore Inspection and Life Assessment
- Weld Overlays in the Nuclear Industry

TRAINING COURSES

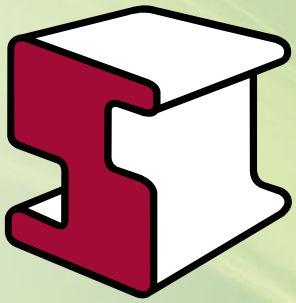
Structural Integrity also offers training courses on various industry topics. A list of past nuclear plant services training courses follows. These and other courses can be provided at your facility or in our offices. We'll also customize courses to your specific needs.

- Advanced Linear Phased-Array Techniques for the Power Industry
- Advanced NDE Techniques for the Power Industry
- ASME Section III and Section XI Design and Analysis
- Corrosion and Corrosion Control in LWRs
- Corrosion and Microbiologically Influenced Corrosion Control
- Financial Risk Optimization for Maintenance/Inspection Planning
- Generator Retaining Ring Inspection and Evaluation
- Introduction to Plant Vibration Solutions
- Materials, Fabrication, and Examination Requirements
- Metal Fatigue and Fracture Mechanics in the Nuclear Industry
- Probabilistic Fracture Mechanics
- Steam Turbine-Generator Rotor Analysis

With over 200 Energy Industry experts and technical staff, Structural Integrity Associates, Inc.® training will prepare you and your facility with the advanced knowledge you need.

Our training includes first hand experiences, real-case scenarios, and years of research, design and leadership. From development of customized solutions such as BloGEORGE and our Buried Piping Integrity Initiative to software development such as MAPPro, pc-CRACK and SI_VersaDAS, to partnering with EPRI, WSI and other industry leaders, you'll learn from the best.

Call us today at 1-877-474-7693.



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